# 14.1 Work and Power

## 1. What is Work?

Work is the product of force and distance.

### Work Requires Motion

### Work Depends on Direction

## 2. Calculating Work

Work = Force X Distance

### Units of Work

A joule is the SI unit of work.

### b) Using the Work Formula

## 3. What is Power?

Power is the rate of doing work.

## 4. Calculating Power

Power = Work / Distance

A watt is the SI unit of power.

## 5. James Watt and Horsepower

Horsepower is a common unit of power. Horsepower is equal to about 746 watts.

# 14.2 Work and Machines

## 1. Machines Do Work

A machine is a device that changes a force

### a) Increasing Force

### b) Increasing Distance

### c) Changing Direction

## 2. Work Input and Work Output

### a) Work Input to a Machine

Input force is the force you exert on a machine.

Input distance is the distance the input force acts through.

Work input is the work done by the input force acting through the input distance.

### Work Output of a Machine

Output force is the force that is exerted by the machine.

Output distance is the distance the output force is exerted through. Work output of a machine is the output force multiplied by the output distance.

# 14.3 Mechanical Advantage and Efficiency

## 1. Mechanical Advantage

Mechanical advantage of a machine is the number of times that the machine increases an input force.

### Actual Mechanical Advantage

Actual mechanical advantage = Output force / Input force

### Ideal Mechanical Advantage

The ideal mechanical advantage (IMA) of a machine is the mechanical advantage in the absence of friction.

## 2. Calculating Mechanical Advantage

Ideal mechanical advantage = Input distance / Output distance

## 3. Efficiency

Efficiency is the percentage of the work input that becomes work output.

Efficiency = Work Output / Work Input X 100%

# 14.4 Simple Machines

## 1. Levers

A lever is a rigid bar that is free to move around a fixed point.

A fulcrum is the fixed point the bar rotates around.

The input arm of a lever is the distance between the input force and the fulcrum.

The output arm is the distance between the output arm and the fulcrum.

### a) First-Class Levers

### b) Second-Class Levers

### c) Third-Class Levers

## 2. Wheel and Axle

A wheel and axle is a simple machine that consists of two disks or cylinders, each one with a different radius.

## 3. Inclined Plane

An inclined plane is a slanted surface along which force moves an object to a different elevation.

## 4. Wedges and Screws

### a) Wedges

A wedge is a V-shaped object whose sides are inclined plane sloped toward each other.

### Screws

A screw is an inclined plane wrapped around a cylinder.

## 5. Pulleys

A Pulley is a simple machine that consists of a rope that fits into a groove in a wheel.

### a) Fixed Pulleys

### b) Movable Pulleys

### c) Pulley System

## 6. Compound Machines

A compound machine is a combination of two or more simple machines that operate together.